CLAIMS:

1. A method of immunotherapy comprising administering to a patient in need thereof an alkaloid at a dose sufficient to induce IL-2 production in dendritic cells in the patient.

2. Use of an alkaloid for the manufacture of a medicament for use in immunotherapy, wherein the immunotherapy comprises the induction of IL-2 production in dendritic cells.

3. The method of claim 1 or use of claim 2 wherein the immunotherapy comprises:

(a) Increasing the Th1:Th2 response ratio, for example in the treatment of Th1-related diseases or disorders (e.g. proliferative disorders or infection) and/or Th2-related diseases or disorders (for example allergies, e.g. asthma);
(b) Haemorestoration;
(c) Alleviation of immunosuppression;
(d) Cytokine stimulation;
(e) Treatment of proliferative disorders;
(f) Vaccination, wherein the alkaloid acts as an adjuvant;
(g) Vaccination, wherein the alkaloid acts to potentiate dendritic cells in situ;
(h) Wound healing.

4. The method of claim 1 or use of claim 2 wherein the immunotherapy comprises immunostimulation in the treatment or prophylaxis of a microbial infection selected from:

(a) a bacterial infection;
(b) a prion infection;
(c) a viral infection;
(d) a fungal infection;
(e) a protozoan infection;
(f) a metazoan infection (e.g. by parasitic nematode).

5. The method or use of claim 4 wherein the immunotherapy comprises the treatment or prophylaxis of an infection in which the infecting pathogen resides intracellularly or causes the expression of neoantigen(s), for example selected from: HIV, leishmania, influenza, tuberculosis and malaria.

6. The method or use of claim 3(b) wherein the haemorestoration is adjunctive to:

(a) chemotherapy; and/or
(b) radiotherapy; and/or
(c) bone marrow transplantation; and/or
(d) haemoablative immunotherapy.

7. The method or use of claim 3(c) wherein the immunosuppression is congenital, acquired (e.g. by infection or malignancy) or induced (e.g. deliberately as part of the management of transplants or cancers).

8. The method or use of claim 3(d) wherein the cytokine stimulation is adjunctive to gene therapy.

9. The method or use of claim 3(e) wherein the proliferative disorder is selected from cancer and cancer metastasis.

10. The method or use of claim 3(f) wherein the vaccine:
    (a) is a cell-based vaccine (e.g. comprising dendritic cells and/or T cells); and/or
    (b) comprises a neoantigen and an alkaloid.

11. The method or use of claim 10 wherein the cell-based vaccine comprises xenogenic, allogenic, syngenic or autogeneic cells.

12. The method or use of claim 3(g) wherein the immunotherapy further comprises:
    (a) the co-administration of an antigen (e.g. a neoantigen), which antigen is optionally targeted to endogenous dendritic cells (e.g. present in an exosome); and/or
    (b) the co-administration of a dendritic cell maturation stimulant.

13. A live cell vaccine comprising an alkaloid.

14. The vaccine of claim 13 comprising xenogenic, allogenic, syngenic or autogeneic cells.

15. The vaccine of claim 14 wherein the cells comprise dendritic cells.

16. The vaccine of claim 15 wherein the dendritic cells are antigen-pulsed dendritic cells.

17. The vaccine of any one of claims 14 to 16 wherein the cells comprise T cells.

18. The vaccine of claim 17 wherein the T cells are primed by contact with dendritic cells, for example by contact with antigen-pulsed dendritic cells.

19. The vaccine of claim 18 wherein the T cells are primed by contact with antigen-pulsed dendritic cells in the presence of the alkaloid.

20. A process for producing a dendritic cell vaccine comprising the step of contacting dendritic cells with an alkaloid at a concentration sufficient to induce IL-2 production in said dendritic cells.

21. The process of claim 20 further comprising the step of loading the dendritic cells with an antigen.

22. The process of claim 20 or claim 21 further comprising the step of maturing the dendritic cells.

23. The process of claim 22 wherein the dendritic cells are matured by contacting them with a maturation medium (for example a maturation medium as defined in claim 32).

24. A dendritic cell vaccine obtained (or obtainable) by the process of any one of claims 20 to 23.

25. A process for producing a T cell vaccine comprising the steps of:
    (a) providing dendritic cells;
    (b) contacting the dendritic cells with an alkaloid at a concentration sufficient to induce IL-2 production in said dendritic cells, thereby to produce stimulated dendritic cells;
    (c) providing T cells;
    (d) priming the T cells by contacting them with the stimulated dendritic cells of step (b).

26. The process of claim 25 further comprising the step of loading the dendritic cells with an antigen and/or maturing the dendritic cells prior to the priming step (d).

27. A T cell vaccine obtained by the process of claim 25 or 26.

28. A method of adoptive immunotherapy comprising administering the T cell vaccine of claim 27 to a patient in need thereof.

29. A method for priming T cells *in vitro* comprising the steps of:
    (a) providing dendritic cells;
    (b) contacting the dendritic cells with an alkaloid at a concentration sufficient to induce IL-2 production in said dendritic cells, thereby to produce stimulated dendritic cells;
    (c) providing T cells;
    (d) contacting the T cells with the stimulated dendritic cells, thereby to produce primed T cells.

30. The method of claim 29 further comprising the step of loading the dendritic cells with an antigen and/or maturing the dendritic cells prior to the priming step (d).

31. A method of adoptive immunotherapy comprising administering T cells primed according to the method of claim 29 or claim 30 to a patient in need thereof.

32. A maturation medium for triggering the maturation of immature dendritic cells into mature dendritic cells, said medium comprising an alkaloid at a concentration sufficient to induce IL-2 production in said dendritic cells.

33. A dendritic cell factory comprising the maturation medium of claim 32.

34. A process for producing mature dendritic cells comprising the step of contacting immature dendritic cells with the maturation medium of claim 32.

35. A process for producing a dendritic cell vaccine comprising the step of contacting immature dendritic cells with the maturation medium of claim 32 (for example in the dendritic cell factory of claim 33).

36. A method of adoptive immunotherapy comprising administering mature dendritic cells produced according to the process of claim 35 to a patient in need thereof.

37. A method for activating resting NK and/or NKT cells *in vivo* comprising the step of administering an alkaloid to a patient in need of NK and/or NKT cell activation at a dose sufficient to induce IL-2 production in endogenous dendritic cells of the patient.

38. A method for potentiating vaccination with dendritic cells in a patient in need thereof comprising the co-administration of an alkaloid at a dose sufficient to induce IL-2 production in said dendritic cells.

39. A method of potentiating vaccination with T cells in a patient in need thereof comprising the co-administration of an alkaloid at a dose sufficient to induce IL-2 production in endogenous dendritic cells of the patient.

40. A method for inducing the maturation of dendritic cells *in vivo* comprising the co-administration of:

(c) a antigen targeted to the dendritic cells; and

(d) an alkaloid at a dose sufficient to induce IL-2 production in said dendritic cells.

41. A method for inducing tolerance in a patient in need thereof comprising the co-administration of immature dendritic cells and an alkaloid.

42. A method for potentiating vaccination with immature dendritic cells comprising the co-administration of an alkaloid at a dose sufficient to induce IL-2 production in said immature dendritic cells.

43. The method of claim 41 or claim 42 wherein the immature dendritic cells are loaded with an antigen.

44. The invention of any one of the preceding claims wherein the alkaloid is isolated.

45. The invention of any one of the preceding claims wherein the alkaloid is selected from:

(a) a piperidines alkaloid;

(b) a pyrroline alkaloid;

(c) a pyrrolidines alkaloid;

(d) a pyrrolizidine alkaloid;

(e) an indolizidine alkaloid;

(f) a nortropanes alkaloid;

(g) mixtures of any two or more of (a) to (f).

46. The invention of any one of the preceding claims wherein the alkaloid is polyhydroxylated.

47. The invention of any one of the preceding claims wherein the alkaloid is a sugar mimic.

48. The invention of any one of the preceding claims wherein the alkaloid has a molecular weight of 100 to 400 Daltons.

49. The invention of claim 48 wherein the alkaloid has a molecular weight of 150 to 300 Daltons (e.g. 200 to 250 Daltons).

50. The invention of any one of the preceding claims wherein the alkaloid is a phytochemical (or a derivative or analogue thereof).

51. The invention of any one of the preceding claims wherein the alkaloid is a polar alkaloid.

52. The invention of any one of the preceding claims wherein the alkaloid induces the production of IL-12 and/or IL-2 from macrophages *in vitro* and/or *in vivo*.

53. The invention of any one of the preceding claims wherein the alkaloid induces, potentiates or activates one or more Th1 cytokines (e.g. IFN-gamma) *in vivo* and/or suppresses one or more cytokines (e.g. Th2 cytokine(s)) *in vivo*.

54. The invention of claim 53 wherein the one or more cytokines comprises one or more interleukins, for example wherein:

(a) the one or more Th1 cytokine(s) comprises IL-12 and/or IL-2; and/or

(b) the one or more Th2 cytokine(s) comprise IL-5 and/or IL-4.

55. The invention of any one of the preceding claims wherein the alkaloid is a glycosidase inhibitor.

56. The invention of claim 55 wherein the alkaloid:

(a) inhibits glucosidase; and/or

(b) does not inhibit mannosidase.

57. The invention of any one of the preceding claims wherein the alkaloid:

(a) modifies tumour cell glycosylation (e.g. tumour antigen glycosylation); and/or

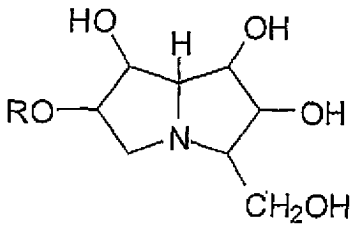
(b) modifies viral protein glycosylation (e.g. virion antigen glycosylation); and/or

(c) modifies cell-surface protein glycosylation in infected host cells; and/or

(d) modifies bacterial cell walls,

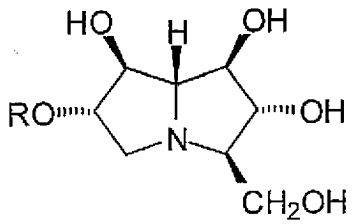
when administered *in vivo*.

58. The invention of any one of the preceding claims wherein the alkaloid has the formula:



wherein R is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl (e.g. cycloalkyl), alkenyl, alkynyl and aryl groups, or a pharmaceutically acceptable salt or derivative thereof.

59. The invention of claim 58 wherein the alkaloid has the formula:



wherein R is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl (e.g. cycloalkyl), alkenyl, alkynyl and aryl groups, or a pharmaceutically acceptable salt or derivative thereof.

60. The invention of claim 58 or claim 59 wherein the alkaloid is an acyl derivative.

61. The invention of claim 60 wherein the alkaloid is:

(a) peracylated; or

(b) acylated at C-3 hydroxymethyl; or

(c) acylated at C-6;

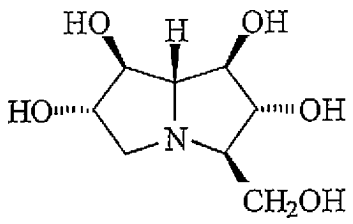
(d) acylated at C-3 hydroxymethyl and C-6.

62. The invention of claim 60 or claim 61 wherein the acyl derivative is alkanoyl or aroyl.

63. The invention of claim 62 wherein the acyl derivative is an alkanoyl selected from acetyl, propanoyl or butanoyl.

64. The invention of any one of claims 58 to 63 wherein R is a saccharide moiety (for example a glucoside or arabinoside moiety).

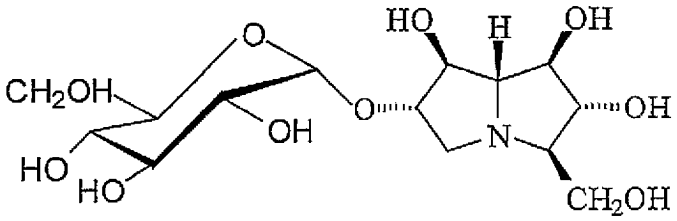
65. The invention of claim 59 wherein the alkaloid is 1R,2R,3R,6S,7S,7aR)-3-(hydroxymethyl)-1,2,6,7-tetrahydroxypyrrolizidine (casuarine), wherein R is hydrogen and having the formula:



or a pharmaceutically acceptable salt or derivative thereof.

66. The invention of claim 59 wherein the alkaloid is a casuarine glycoside, or a pharmaceutically acceptable salt or derivative thereof.

67. The invention of claim 66 wherein the alkaloid is casuarine-6-α-D-glucoside of the formula:



or a pharmaceutically acceptable salt or derivative thereof.

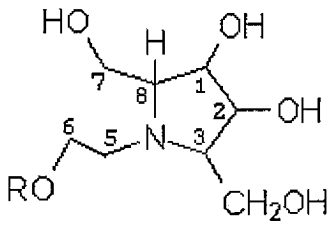
68. The invention of claim 59 wherein the alkaloid is 6-O-butanoylcasuarine, or a pharmaceutically acceptable salt or derivative thereof.

69. The invention of claim 58 wherein the alkaloid is selected from:

(a) 3,7-diepi-casuarine;
(b) 7-epi-casuarine;
(c) 3,6,7-triepi-casuarine;
(d) 6,7-diepi-casuarine;
(e) 3-epi-casuarine;
(f) 3,7-diepi-casuarine-6-α-D-glucoside;
(g) 7-epi-casuarine-6-α-D-glucoside;
(h) 3,6,7-triepi-casuarine-6-α-D-glucoside;
(i) 6,7-diepi-casuarine-6-α-D-glucoside; and
(j) 3-epi-casuarine-6-α-D-glucoside,

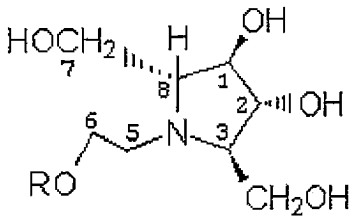
or a pharmaceutically acceptable salt or derivative thereof.

70. The invention of any one of claims 1 to 57 wherein the alkaloid has the formula:



wherein R is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl (e.g. cycloalkyl), alkenyl, alkynyl and aryl groups, or a pharmaceutically acceptable salt or derivative thereof.

71. The invention of claim 70 wherein the alkaloid has the formula:



wherein R is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl (e.g. cycloalkyl), alkenyl, alkynyl and aryl groups, or a pharmaceutically acceptable salt or derivative thereof.

72. The invention of claim 70 or claim 71 wherein the alkaloid is an acyl derivative.

73. The invention of claim 72 wherein the alkaloid is:

(a) peracylated; or

(b) acylated at C-3 hydroxymethyl; or

(c) acylated at C-6;

(d) acylated at C-3 hydroxymethyl and C-6.

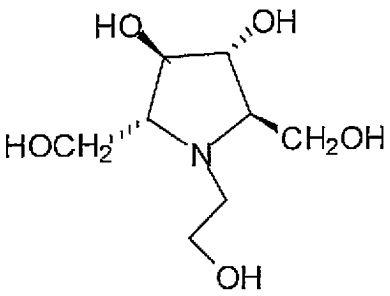
74. The invention of claim 72 or claim 73 wherein the acyl derivative is alkanoyl or aroyl.

75. The invention of claim 74 wherein the acyl derivative is an alkanoyl selected from acetyl, propanoyl or butanoyl.

76. The invention of any one of claims 70 to 75 wherein R is a saccharide moiety.

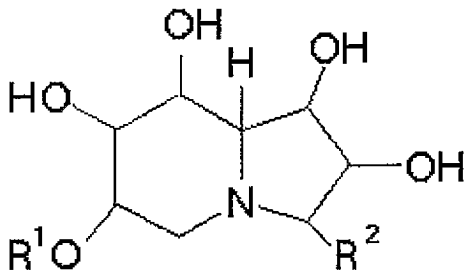
77. The invention of claim 76 wherein R is a glucoside or arabinoside moiety.

78. The invention of claim 71 wherein the alkaloid is N-hydroxyethylDMDP wherein R is hydrogen and having the formula:



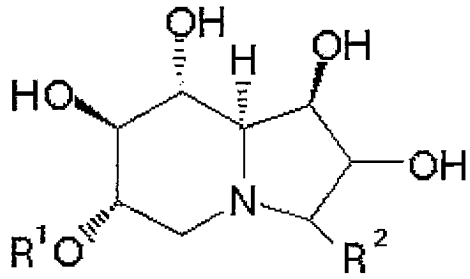
or a pharmaceutically acceptable salt or derivative thereof.

79. The invention of any one of claims 1 to 57 wherein the alkaloid has the formula:



wherein R^1 is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl (e.g. cycloalkyl), alkenyl, alkynyl and aryl groups and R^2 is selected from hydrogen, hydroxy and alkoxy, or a pharmaceutically acceptable salt or derivative thereof.

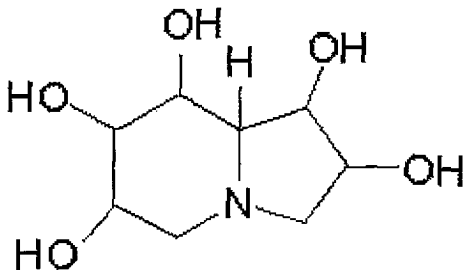
80. The invention of claim 79 wherein the alkaloid has the formula:



wherein R^1 is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl (e.g. cycloalkyl), alkenyl, alkynyl and aryl groups and R^2 is selected from hydrogen, hydroxy and alkoxy, or a pharmaceutically acceptable salt or derivative thereof.

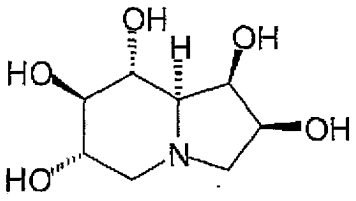
81. The invention of claim 79 or claim 80 wherein R^1 is a saccharide moiety (for example a glucoside or arabinoside moiety).

82. The invention of claim 79 wherein the alkaloid has the formula:



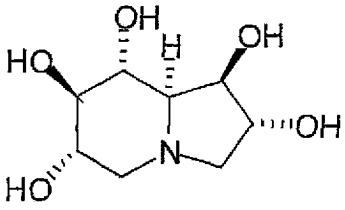
or a pharmaceutically acceptable salt or derivative thereof.

83. The invention of claim 82 wherein the alkaloid is 2-hydroxy-1,2-cis-castanospermine having the formula:



or a pharmaceutically acceptable salt or derivative thereof.

84. The invention of claim 82 wherein the alkaloid is 2-hydroxy-1,2-trans-castanospermine having the formula:



or a pharmaceutically acceptable salt or derivative thereof.

85. The invention of any one of claims 79 to 84 wherein the alkaloid is an acyl derivative.

86. The invention of claim 85 wherein the acyl derivative is alkanoyl or aroyl.

87. The invention of claim 86 wherein the acyl derivative is an alkanoyl selected from acetyl, propanoyl or butanoyl.